October 18, 2000

Summary of EPA's Concern about Temperature in the Columbia River System

Attainment of Water Quality Standards

- Attached figures illustrate water temperature during the hot part of the year at Ice Harbor Dam with the dams in place (blue line) and with the dams removed (pink line).
- The purpose is not to argue that the dams should be removed but to show the natural temperature regime of the river. State WQS allow exceedances of 20 C as part of the natural temperature regime but do not allow exceedances of 20 C caused by human activities.
- In the attached figures exceedances occur whenever the blue line is higher than the pink line.
- The instantaneous daily water temperature is often much greater in the impounded river than in the natural river, clearly exceeding water quality standards.
- High water temperatures exceeding 20 C don't last as long seasonally in the natural river as the high water temperatures in the impounded river.
- The maximum water temperatures in the natural river are accompanied by large diurnal fluctuations resulting in lower water temperatures in the evening; as much as 1.5 C lower. The impounded river does not cool off at night.

Significance of High Water Temperature on Salmon

- Direct mortality of juvenile salmon at McNary dam has been documented.
- Delayed migration of adults has been documented. Delay of upstream migration has been shown to inhibit spawning success. In the Frazier River few adults reached the spawning grounds when delayed 10 - 12 days (Snyder and Blahm, 1971)
- During freshwater life history stages of salmon, the water temperatures to which juvenile and adult salmon are exposed are among the most significant determinants of both individual viability and stock survival and recovery (Coutant 1999, McCoullough 1999).
- EPA's Biological Assessment prepared for consultation with NMFS and USFWS on Oregon's Water Quality Standards for temperature summarizes the literature on sub-lethal effects of warmer temperatures on salmon. That BA indicated that temperatures as low as 17.8 C have sublethal effects that can lead to mortality and reduced vitality of the stock.

- Those sublethal effects when mature adults are subject to 17.8 C and higher include:
  - inhibition of ovulation and reduced gamete quality;
  - greater prehatch mortality and developmental abnormalities;
  - faster use of energy reserves resulting in reduced fitness and reproductive success;
  - reduced competitive success against species more suitable to warm water;
  - greater susceptibility to disease and predation.

- Holtby (1988) demonstrated that elevated temperatures 1) can have quantifiable effects on salmonid populations; 2) these effects can influence more than one life stage simultaneously; 3) the effects of perturbations at one life stage can persist throughout the remainder of the life cycle; and 4) for anadromous species, the effects of habitat perturbations during freshwater rearing can persist into the marine phase.

Temperature Dynamics in a Free Flow Versus Slack Water Regime

- Prior to dams the Snake River experienced seasonal water temperature exceedances of 20°C. However, it is misleading to conclude from that fact that temperatures over 20 C must not be harmful to salmon.

- It is misleading to compare the water quality of two different aquatic systems based solely on instantaneous maximum water temperature measurements.

- The natural river had much greater diurnal temperature variation than the impounded river, providing cooler water at night. The natural river reacted much faster to weather patterns than the impounded river, cooling off due to weather that would not affect the impounded river.

- In a natural river state, tributary confluences, seeps and springs, and points of up welling from hyporheic and ground water sources bring cool water to the main river.

- Over time, salmon have evolved in response to these more natural conditions. Other in stream and riparian compensatory factors help salmon cope with seasonal and daily periods of elevated stream temperatures. These factors have been thoroughly described in a number of recent publications (Coutant 1999, McCoullough 1999, ISG 1996).

Cumulative impacts

- Temperature works in concert with other factors brought about by damming the river.

- The passage time through the river reach is many times longer. So juvenile salmon are subjected to the stressful temperatures much longer.

- Many of the salmon juveniles are passive migrants that let the current carry them downstream. In impounded conditions they have to swim, using up energy reserves already stressed by adverse temperatures.

- The food organisms available in the impounded river are different from those in a natural river.
- Warmer temperatures favor introduced predators and disease organisms.